The American Fertilizer

Vol. 93 MARCH 13, 1943 No. 6

Published every other Saturday. Annual subscription: In the United States, $3.00; Canada and Mexico, $4.00; other countries, $5.00. Entered as second-class matter, January 15, 1910, at the Post Office at Philadelphia, Pa. under Act of March 3, 1879. Registeredin United States Patent Office. Publication office, 1330 Vine St., Phila., Pa.

See page 27

...THE...

AMERICAN FERTILIZER

"That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

Vol. 98 MARCH 13, 1943 No. 6

Carbon-Hydrogen Ratios in Organic Fertilizer Materials in Relation to the Availability of Their Nitrogen[1]

By EDWARD J. RUBINS and FIRMAN E. BEAR[2]

New Jersey Agricultural Experiment Station

THE NITROGEN of fertilizer materials of animal or vegetable origin is, for the greater part, combined in complex proteinaceous compounds many of which are largely insoluble in water. If such nitrogen is to be converted to soluble forms that are utilizable by plants, the parent materials must be subjected to the agencies of decomposition in the soil.

The use of organic fertilizer materials has suffered a relative decline since the beginning of large-scale production of soluble inorganic nitrogen salts. Their cost has also risen as the better materials have gone more and more into stock feed, forcing the fertilizer mixer to compete with the feed manufacturer, who can generally pay a better price.

Despite this, a demand for natural organic forms of nitrogen persists. This is especially true in regions of high rainfall and sandy soils, and in connection with the production of crops of high acre value. To fill this demand, organic materials that are unfit for feeds are used either in their natural state or after pretreatment with steam or acid to make their nitrogen more available to plants. In some cases low-nitrogen organic materials are used in mixed fertilizers as conditioners rather than for the nitrogen they contain.

The availability to plants of the nitrogen of organic fertilizer materials, known to the trade as organic ammoniates, varies greatly. In order to evaluate such nitrogen, control chemists, using vegetative tests as reference points (2)*, have subjected the water-insoluble portions of such ammoniates to various chemical treatments, among which the neutral and alkaline permanganate methods are the best known. Other workers (4) have employed ammonification and nitrification procedures. More recently, soil chemists and bacteriologists have made use of the principle of the carbon-nitrogen ratio to explain the differences in the availability of the nitrogen in soil organic matter (3, 6). It seemed worth while, therefore, to consider this principle for possible application in evaluating the nitrogen of organic ammoniates as well.

EXPERIMENTAL PROCEDURES

Preparation and Analysis of Materials

Thirty-four organic materials, most of which could properly be classed as ammoniates, were collected and prepared for use in this study. Subsamples were taken from the air-dry materials and ground to pass a 1-mm. sieve, either an iron mortar or a Wiley mill being used.

Since it was desired to conduct much of the work on the water-insoluble fraction of these materials, a method was devised to free 100-gm. portions of them of soluble matter

[1] Journal Series paper of the New Jersey Agricultural Experiment Station, Rutgers University, department of soil chemistry and microbiology. Reprinted from *Soil Science*, Vol. 54, No. 6, December, 1942.

[2] The authors wish to thank F. W. Parker, agronomist for the E. I. duPont Company, for many helpful suggestions during the course of this study, and the Company, for partly financing the project.

* Numbers in parentheses refer to references at the end of the article.

with a minimum expenditure of time. That amount of each material, moistened with alcohol, was stirred with 1500 ml. of distilled water, which was then decanted through a Sharples supercentrifuge. This process was repeated three times. The residue, including the rotor contents, was transferred to a Büchner funnel, given a final washing, and dried at 50°C. After this treatment, 15 of the 32 materials so washed averaged more than 98 per cent, 12 between 95 and 98 per cent, and none less than 89.4 per cent insoluble matter. The materials and their analyses are listed in Table 1.

Vegetative Test

For greenhouse studies of the availability of the nitrogen of these organic materials, 2-gallon pots, each containing 18 pounds of the A_p horizon of Collington sandy loam,

TABLE 1

Nitrogen and Insoluble-matter Content of Unwashed and Washed Organic Materials

MATERIAL	UNWASHED				WASHED
		Water-insoluble Nitrogen			
	Total Nitrogen	Of Total Weight	Of Total Nitrogen	Water-Insoluble Matter	Total Nitrogen
	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT
Seed Meals:					
Soybean meal	7.60	6.40	84.2	62.4	10.30
Cottonseed meal	7.24	6.73	93.0	76.5	8.70
Special soybean meal*	7.69	2.53	32.9	35.1	6.43
Castor pomace	5.03	4.67	92.8	86.1	5.12
Cocoa meal	2.98	1.91	64.1	69.2	2.95
Ground cocoa cake	3.06	2.29	74.8	87.1	2.85
Plant Materials:					
Alfalfa hay	2.82	1.48	52.5	69.9	2.19
Tobacco stems	1.00	0.53	53.0	46.0	0.88
Peanut hull meal	1.24	0.98	79.0	86.5	0.89
Wheat straw	0.308	0.190	61.7	90.1	0.235
Process Tankages:					
Hynite	9.57	8.21	85.8	80.4	10.07
Processed tankage	9.76	7.88	80.7	80.4	9.78
Agrinite	8.52	7.08	83.1	74.3	9.01
Smirow	7.01	6.60	94.2	82.2	7.92
Animal products:					
Hoof meal	14.28	8.67	60.7	56.9	14.48
Bone meal	4.16	4.15	99.8	93.2	4.39
Dried blood	13.83	13.49	97.5	91.2	14.66
Dry fish scrap	9.28	8.22	88.6	83.7	9.83
Animal tankage	8.83	5.65	64.0	65.8	7.93
Acid fish scrap	8.54	5.82	68.1	66.5	8.43
Manures:					
Peruvian guano	13.95	6.13	43.9	55.5	14.40
Bovung	2.01	1.40	69.7	80.6	1.76
Horse manure	1.45	1.16	80.0	80.1	1.32
Chicken manure	2.25	0.74	32.9	86.0	1.02
Sewage products:					
Milorganite	5.66	5.07	89.6	88.0	6.04
Nitroganic tankage	5.93	5.72	96.5	94.3	6.00
Sewage sludge	1.78	1.59	89.3	88.5	1.82
Plastics:					
Beetle molded scrap†	19.76	19.42	98.3	97.5	20.10
Beetle scrap dust†	19.02	13.66	71.8	70.1	16.00
Ford molded scrap‡	2.12	....	....	....	....
Ford molding powder‡	2.08	....	....	....	....
Miscellaneous:					
Cocoa tankage	2.52	1.98	78.6	75.9	2.51
Garbage tankage	2.66	2.49	93.6	80.4	2.80
Manito humus	2.48	2.48	100.0	84.4	2.71

* Processed to have a high content of water-soluble nitrogen.

† A urea-formaldehyde plastic.

‡ A phenol-formaldehyde-soybean plastic.

were used. After a standard treatment of dolomitic limestone, superphosphate, and muriate of potash, the various materials were added to and mixed with the entire volume of soil in each pot. The rate of fertilization was 1600 pounds of a 5–10–10 mixture per 2,000,000 pounds of soil, supplying 0.3266 gm. of nitrogen per pot. The soil was seeded to Sudan grass which, thinned to 12 plants per pot, was grown for 60 days from mid-April, 1942. Green and dry weights and nitrogen content were obtained on the tops, and dry weight and nitrogen content on the roots.

Nitrification Method

The method adopted to test the rate of nitrification of the nitrogen contained in the various materials consisted of mixing the amount of each material that would supply 20 mgm. of nitrogen with a 100-gm. portion of Collington sandy loam, placing the mixture in a 500-ml. Erlenmeyer flask, and incubating it at 28°C. under optimum moisture conditions. Preliminary tests having shown that the addition of potassium and phosphorus, as K_2HPO_4, to the cultures had little effect upon the results obtained, only $CaCO_3$ (0.2 gm. per flask) was added to the soil as a supplement to the organic material. Nitrates were determined by the phenyldisulfonic acid method at the end of the incubation periods.

The procedure yielded reproducible results. For example, the amounts of added nitrogen recovered as nitrate from unwashed dried blood, after 20 days' incubation, varied only between 57 and 62 per cent in six experiments conducted at various intervals over a period of 9 months. The variation in recovery of nitrate after 40 days varied only between 63 and 69 per cent in seven similar tests. Correspondingly good reproducibility was obtained with other materials.

EXPERIMENTAL RESULTS

Vegetative and Nitrification Experiments

The average recovery of added nitrogen in the tops and roots of Sudan grass when grown on soil to which the several organics[3], urea, and unwashed dried blood had been applied are listed in Table 2. Comparison of the nitrogen recoveries by the vegetative test with those obtained from the same materials by the nitrification procedure, shows that the values with the two methods agree rather closely. Negative values resulted in the nitrification test when materials were added whose composition was such that all the nitrogen released by the organic material, as well as some or all of that in the substrate, was utilized by the soil microorganisms. This negative scale was made possible by the fact that a considerable amount of nitrate nitrogen was produced in check soil cultures to which no nitrogen carrier had been added. An analogous situation, in conjunction with the vegetative test, also resulted in negative nitrogen-recovery values.

Availability ratings greater than 50 per cent were found for the insoluble nitrogen of soybean meal, cottonseed meal, castor pomace, hoof meal, dried blood, dry fish scrap, and Peruvian guano, by both the vegetative and the nitrification procedures. The nitrogen of the special soybean meal and acid fish scrap was 50 per cent or more available by the 40-day nitrification test (compare with Table 5) but not by the 60-day vegetative test. In contrast, more than 50 per cent of the nitrogen of Milorganite became available by the 60-day vegetative test but not by the 40-day nitrification test. The insoluble nitrogen of Peruvian guano showed the highest availability of any of the washed organics, 67 per cent of its nitrogen being converted to nitrate in 20 days, and 67.8 per cent being recovered in the vegetative test. The corresponding percentages for urea were 87 and 87.9 for the nitrification and vegetative tests, respectively.

Of the materials that contained more than 3 per cent nitrogen, the process tankages rated among the lowest in nitrogen availability, ranging between 12.9 and 24.1 per cent by the vegetative test and between 12 and 33 per cent by the nitrification procedure. The insoluble nitrogen of bone meal showed even lower availability. Acid fish scrap rated considerably higher by the nitrification test than by the vegetative method. The insoluble nitrogen of Beetle scrap dust, a urea-formaldehyde resin containing a quantity of molding powder, showed fair availability, whereas that of the scrap molded material, which had been subjected to heat treatment during the molding process, gave availability values close to zero. With these exceptions, washed organics containing 3 per cent or more nitrogen rated comparatively high, whereas those containing lesser amounts ranked below.

The A.O.A.C. alkaline and neutral permanganate numbers for the organics are also given in Table 2. A satisfactory source of nitrogen should rate higher than 50 by the alkaline and higher than 80 by the neutral permanganate method, but only a failure in both tests can condemn the insoluble nitrogen

(Continued on page 22)

[3] Throughout this paper, when unspecified as to whether the organics are washed or unwashed, reference is to the washed materials.

THE AMERICAN FERTILIZER
ESTABLISHED 1894
PUBLISHED EVERY OTHER SATURDAY BY
WARE BROS. COMPANY
1330 VINE STREET, PHILADELPHIA, PA.

A MAGAZINE INTERNATIONAL IN SCOPE AND CIRCULATION DEVOTED EXCLUSIVELY TO THE COMMERCIAL FERTILIZER INDUSTRY AND ITS ALLIED INDUSTRIES

PIONEER JOURNAL OF THE FERTILIZER INDUSTRY

WARE BROS. COMPANY
PUBLISHERS
1330 VINE STREET PHILADELPHIA, PA.
A. A. WARE, EDITOR

ANNUAL SUBSCRIPTION RATES

U. S. and its possessions, also Cuba and Panama	$3.00
Canada and Mexico	4.00
Other Foreign Countries	5.00
Single Copy	.25
Back Numbers	.50

Vol. 98 MARCH 13, 1943 No. 6

Principal Articles in This Issue

Price Regulations Applied to More Fertilizers

Additional nitrogenous fertilizer materials have been brought under the same kind of margin control as that provided last March in the original regulation covering nitrate of soda, sulphate of ammonia and calcium cyanamide, the Office of Price Administration announced March 11th. Materials now included are ammonium nitrate, ammonium phosphate, castor pomace, fish meal, fish scrap, nitrate of soda-potash, and urea compound.

The average of maximum prices to consumers for these nitrogen materials will not be materially different under the new regulation from the average allowed by the General Maximum Price Regulation.

Revised Maximum Price Regulation No. 108, effective March 15, allows manufacturers and dealers to establish maximum prices to consumers by adding a specified dollars-and-cents margin above their cost of the materials.

The $4 margin permitted under the original regulation amounted to approximately 10 per cent of the price to the consumer for the three materials covered. The revised regulation, applying also to materials costing more per ton than the three previously covered, maintains a maximum margin of about 10 per cent by providing a sliding scale of gross margins, varying in proportion to the cost of materials to the fertilizer manufacturer.

The Western States, exempted from the original regulation, are now covered. In accord with the established practice of the industry and in recognition of high costs of distribution, fertilizer manufacturers in the West are allowed margins higher than those in the East.

The new regulation provides that maximum prices to consumers shall be determined by adding a margin to the maximum price which may be charged the fertilizer manufacturer or dealer for the material. If a domestic seller of a nitrogenous material chooses to allow fertilizer manufacturers or dealers a greater margin than that provided in the regulation, he may do so by selling his product to those manufacturers or dealers at less than his maximum price.

Application of the margin to the maximum price which may be charged rather than to the price which actually is paid by the fertilizer manufacturer or dealer, results in a fixed maximum price to consumers instead of one

which might fluctuate with each lot of materials purchased.

The revised regulation allows the same total amount ($1.50 per ton) as was provided under the original regulation to cover the cost of bagging and other handling of bulk materials bagged by the fertilizer manufacturer. However, the revision provides that $1 of that amount shall be for bagging, and 50 cents for warehousing and handling. The charge of 50 cents likewise may be passed along on materials purchased in bags but stored and handled through the plant of the fertilizer manufacturer. Dealers or agents who perform a warehousing service also may charge 50 cents per ton for that service in addition to the regular margin.

The fertilizer manufacturer is allowed a maximum amount of $1.50 per ton to cover costs of grinding materials such as fish scrap and castor cake, which must be additionally processed to be made suitable for consumer use.

Georgia Bill Imposes Fertilizer Penalties

House Bill 243 has passed the Georgia House of Representatives in amended form. It would impose a penalty of 25 per cent of the purchase price plus any actual shortage in commercial value on any fertilizer with 10 per cent or more shortage in one or more plant foods or on any fertilizer with 5 per cent or more shortage in commercial valuation or for any sales made without compliance with the requirements of the law.

Any sample drawn from 10 per cent of the containers, or from all containers in lots of 10 or less, is made a legal sample. Any fertilizer containing chemical nitrogen of 8 per cent or less derived from any form of liquid ammonia must state on each bag what per cent of said nitrogen is so derived.

Supreme Court to Review AAA Fertilizer Tax Case

A decision by a three-judge federal court in Tallahassee, Fla., holding that Florida authorities could not exact a fee from the federal government for inspecting fertilizer distributed to farmers in the State by the government under the agricultural production programs was taken under review by the Supreme Court of the United States March 1st.

Florida officials sought to impose an inspection fee of 25 cents a ton on the fertilizer, but on appeal by the government the three-judge court ruled that "such federal property and transactions are immune from State regulations." The Supreme Court's ruling in the case is expected to have an important bearing on the validity of acts of agents in other States which have laws requiring inspection of fertilizer and imposition of fees for such inspections.

Wisconsin Fertilizers Increase

Consumption of fertilizer in Wisconsin during calendar year 1942 as reported by W. B. Griem, State chemist, totaled 132,154 tons. Consumption in the calendar year 1941 amounted to 84,120 tons; 1940, 64,253 tons; and for the five-year average 1935–1939, 38,505 tons. The 1942 figure includes 5,166 tons of phosphate and phosphate-potash mixtures delivered in 1941 by AAA for use in 1942, and 30,568 tons delivered in 1942 for use in 1942. This figure does not include 29,074 tons delivered in 1942 for use in 1943. Complete fertilizer sold in 1942 totaled 61,968 tons as compared to 45,767 tons sold in 1941.

January Sulphate of Ammonia

The figures issued by the U. S. Bureau of Mines show no change in the production of by-products sulphate of ammonia and ammonia liquor. The output is still at the rate of slightly over 2,000 tons per day of sulphate of ammonia, and a little less than 100 tons per day of ammonia liquor. While shipments of sulphate during the month decreased slightly from December figures, they are still above production, with the result that stocks on hand dropped to 40,592 tons. This is almost twice the amount on hand on January 31, 1942, and shows the effect of allocation on supplies of this material.

	SULPHATE OF AMMONIA	AMMONIA LIQUOR
Production	*Tons*	*Tons NH_3*
January, 1943	64,116	2,917
December, 1942	63,813	2,871
January, 1942	65,548	2,904
Shipments		
January, 1943	66,914	2,831
December, 1942	69,740	3,000
January, 1942	74,955	3,056
Stocks on Hand		
January 31, 1943	40,592	1,202
December, 31, 1942	43,688	1,017
January 31, 1942	21,585	896
December 31, 1941	31,091	757

An Appraisal of Different Phosphatic Material As Sources of Phosphorus for Crop Plants: A Greenhouse Study[1]

By BAILEY E. BROWN[2]

THIS PAPER presents preliminary results of greenhouse pot-culture studies comparing various phosphatic materials with ordinary superphosphate to determine their potential nutrient value for crop plants grown on different soils.[3] The crop-plant indicator employed was millet (German). Soils used were: Norfolk loamy fine sand, pH 5.5; Caribou loam, pH 4.6; Chester loam, pH 6.5; and Sassafras fine sandy loam, pH 5.6. The phosphates tested and their total P_2O_5 content are given in Table 1.

Outline of Experimental Procedure

Uniform greenhouse methods were followed, the crop-plant indicator—millet—being grown in 1-gallon pots holding 5 kilos of soil. In all respects, similar cultural conditions were imposed throughout the studies, except to vary the source of phosphorus in accordance with the composition of the phosphates under comparison. A control series, N–K[4], was run to determine what effect the addition of the phosphate had on growth over and above the combined effect of nitrogen and potassium materials. Results obtained with German millet are given in Table 2.

Discussion of Results

An examination of the results presented in Table 2 indicates that each material gave a good account of itself. One material in particular—triple calcium-magnesium superphosphate—produced higher yields than superphosphate on all soils; calcined phosphate exceeded superphosphate on three soils; fused phosphate rock and triple superphosphate, on two; and dicalcium phosphate, on one. If the millet weights for all soils for the respective fertilizer treatments are combined and expressed relatively with superphosphate at 100, the phosphates assume the following order:

(1) Triple calcium-magnesium superphosphate	106.4
(2) Calcined phosphate	102.8
(3) Fused phosphate rock	101.7
(4) Superphosphate	100.0
(5) Triple superphosphate	100.0
(6) Dicalcium phosphate	96.0
(7) N–K (No-phosphorus control)	71.5

TABLE 1
Phosphate Materials Used in Greenhouse Experiments

	TOTAL P_2O_5 *Per cent*
Ordinary superphosphate(*a*)	20.15
Calcined phosphate (*b*)	35.1
Dicalcium phosphate (*c*)	43.9
Fused phosphate rock (*c*)	29.0
Triple superphosphate (*d*)	53.5
Triple calcium-magnesium superphosphate (*d*)	52.4

(*a*) Commercial product.

(*b*) Supplied by Division of Soil and Fertilizer Investigations, Bureau of Plant Industry, U.S.D.A., through Mr. K. D. Jacob.

(*c*) T. V. A. products, furnished by Dr. H. A. Curtis.

(*d*) Supplied by Dr. W. H. MacIntire, Tennessee Agricultural Experiment Station.

[1] One of a series of greenhouse pot-culture studies made to evaluate the nutrient efficiency of the phosphorus in different phosphatic materials for crop plants. One of the main objects for conducting the greenhouse tests was to obtain what might be termed a nutrient-index reading on various phosphatic materials before attempting large-scale field comparisons on potatoes. Any material found to be deficient in nutrient value could be eliminated. In the various greenhouse experiments ordinary superphosphate has been used as the standard source of phosphorus.

[2] Senior biochemist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture.

[3] A description of the materials tested will be furnished on request. The writer prefers to do this for the sake of brevity; also because such matters are outside his province. Any request for information will be referred to the individuals concerned in the production of the listed materials.

[4] 5-0-8 mixture.

Greenhouse Results Showing Relative Efficiencies of Various Phosphorus Sources as Measured by the Growth of Millet (German) on Different Soils.

ACTUAL AND RELATIVE RESULTS WITH MILLET GROWN ON FOUR SOILS. TOTAL WEIGHT OF 30 PLANTS. MOISTURE-FREE BASIS.

PHOSPHORUS MATERIALS USED IN 5–12–8 MIXTURE*	Caribou Loam, pH 4.6		Chester Loam, pH 6.5		Norfolk Loamy Fine Sand, pH 5.5		Sassafras Fine Sandy Loam, pH 5.6	
	Actual	Relative	Actual	Relative	Actual	Relative	Actual	Relative
	GRAMS	PER CENT	GRAMS	PER CENT	GRAMS	PER CENT	GRAMS	PER CENT
Superphosphate	72.6	100.0	50.2	100.0	55.4	100.0	63.5	100.0
Calcined phosphate	75.0	103.3	49.0	97.6	58.4	105.4	66.1	104.1
Dicalcium phosphate	66.3	91.3	48.6	98.6	57.8	104.3	59.3	93.3
Fused phosphate rock	71.5	98.6	47.0	93.6	59.0	106.5	68.4	107.8
Triple superphosphate	70.8	97.7	48.7	97.0	59.0	106.5	64.0	100.8
Triple calcium-magnesium superphosphate	74.5	102.8	56.3	112.1	57.5	103.8	68.8	108.3
N-K (5-0-8)	54.8	75.5	32.0	63.7	31.3	56.5	54.7	86.1

*Nitrogen derived equally from sodium nitrate, ammonium sulphate, and cottonseed meal. Rate of nitrogen application, 100 lb. per acre. Phosphoric acid derived from sources enumerated; rate of application, 240 pounds per acre, calculated on basis of total P_2O_5. Potash derived from manure salts. Same application of MgO—38 lb. per acre—made to each pot. All treatments were replicated three times with 10 plants per pot. Nutrients mixed with soil by means of a mechanical mixer.

On the strength of the foregoing comparison, one is justified in giving each material a performance rating comparable to that of superphosphate.

Summary

A study was made to evaluate the nutrient efficiency of a number of comparatively new phosphates by means of greenhouse pot-culture studies using millet (German) as the indicator crop. The phosphates compared with superphosphate as sources of P_2O_5 for millet were: Calcined phosphate, dicalcium phosphate, fused phosphate rock, triple superphosphate, and triple calcium-magnesium superphosphate. Different soils were employed—Caribou loam, Chester loam, Norfolk loamy fine sand, and Sassafras fine sandy loam. When the results are considered on a relative basis, putting ordinary superphosphate at 100, the plant-growth range was from 96 per cent for the lowest yield of millet to 106.4 for the highest, indicating a satisfactory behavior on the part of the phosphates in the greenhouse pot-culture tests.

Ammonia Nitrate, a New Chemical Fertilizer

One of the most interesting recent developments in the fertilizer materials situation has been the release by the War Production Board of the unusual chemical nitrogenate, ammonia nitrate, produced in the Province of Ontario, Canada, for direct application to the soil in the delta lands of Arkansas, Mississippi and Louisiana and also in Virginia, North Carolina and South Carolina. This material, hitherto employed chiefly in making explosives, is in the form of a mixture containing 34 per cent of nitrogen, associated with limestone.

Shipments of this mixture are made from Fort Robinson, Ontario, at a price of $56.65 per net ton, f. o. b. Fort Robinson. Some weeks ago, about 3,650 tons were shipped from British Columbia to California ports where they sold immediately at $77.80 per ton, f. o. b. San Francisco, and $80.25 f. o. b. Los Angeles.

Burrows Vice-President of Minerals Separation

John T. Burrows, formerly president of Phosphate Recovery Corporation, is now vice-president of Minerals Separation North American Corporation and will be located at the company's offices, 11 Broadway, New York.

The Minerals Separation North American Company, which controls all patent rights on metal recovery by the "oil flotation" process, has acquired the business and assets of the Phosphate Recovery Corporation. The activities of the latter company will be continued from 11 Broadway, New York City and from the laboratories at Lakeland, Florida and Hibbing, Minnesota.

Simms Promoted by Naco

Robert Simms, formerly manager of the Findlay, Ohio, plant of the Naco Fertilizer Company, has been elected to the office of vice-president and general manager. He will be located at the main offices of the company, 104 Pearl Street, New York City.

February Tax Tag Sales

Factors affecting the fertilizer situation have favored an increase in sales in recent months. Larger farm production is called for this year; farm purchasing power is abnormally high and is still climbing; fertilizer prices are relatively low in comparison with prices farmers receive for their products. It has been wise policy on the part of farmers to buy early in order to avoid possible later shortages due to transportation difficulties. A policy of early buying has been advocated by the fertilizer industry for many years.

These factors are reflected in the 16 per cent rise in February tag sales over last year. The 69 per cent increase over February, 1941, is due primarily to the earlier buying of tags rather than to an abnormally large increase in demand for fertilizer. It is particularly significant that in 16 of the 17 reporting States February sales were larger this year than last.

For January and February combined, sales were 5 per cent larger than in 1942. They were nearly double the sales in the 1941 period. Not until the March and April sales figures are available will it be possible to determine if the increase to date is indicative of larger consumption or is entirely due to earlier buying.

Reed Joins OPA Staff

James Reed, for many years with International Minerals and Chemical Corp., has been appointed head of the Atlanta of the Cereals, Feeds and Agricultural Chemicals Branch of OPA. With offices in the Candler Building, he will cover feeds, fertilizers, insecticides, seeds, and cereal products in 8 states.

FERTILIZER TAX TAG SALES

STATE	February 1943 Tons	February 1942 Tons	February 1941 Tons	% '42	January–February 1943 Tons	January–February 1942 Tons	January–February 1941 Tons
Virginia	64,422	63,470	64,519	80	124,694	156,518	97,169
North Carolina	298,931	267,898	146,582	82	513,383	628,856	254,130
South Carolina	208,889	208,552	119,936	110	363,210	329,725	170,038
Georgia	248,370	238,543	124,820	128	408,213	317,792	169,902
Florida	75,196	68,560	69,294	110	177,470	160,717	150,388
Alabama	195,700	147,700	82,000	125	316,750	253,050	124,900
Mississippi	77,643	64,965	69,689	124	171,807	138,915	132,939
Tennessee	42,613	28,040	21,950	129	56,351	43,579	29,608
Arkansas	40,090	32,350	18,450	104	72,790	70,250	47,000
Louisiana	39,413	30,197	22,150	123	68,813	55,947	61,100
Texas	33,480	19,955	22,620	176	52,705	44,580	42,980
Oklahoma	5,350	2,900	3,186	266	9,450	3,550	5,686
TOTAL SOUTH	1,330,097	1,173,130	765,196	106	2,340,636	2,203,479	1,285,840
Indiana	72,500	50,004	62,847	83	122,350	147,568	70,608
Illinois	15,429	6,825	3,225	154	34,180	22,190	4,148
Kentucky	6,005	22,158	19,313	37	14,235	38,781	25,401
Missouri	25,793	2,769	6,797	279	28,852	10,348	13,813
Kansas	1,253	290	877	427	1,303	305	4,217
TOTAL MIDWEST	120,980	82,046	93,059	92	200,920	219,192	118,187
GRAND TOTAL	1,451,077	1,255,176	858,255	105	2,541,556	2,422,671	1,404,027

FERTILIZER MATERIALS MARKET

NEW YORK

Ammonia Liquor Allocation Fails to Relieve Nitrogen Situation. Potash Shipments After April 1st Must Have Government Approval. North African Phosphate May Help Superphosphate Problems

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, March 9, 1943.

Sulphate of Ammonia

Further quantities of this material have been allocated for export. Ammonia liquor is still available for fertilizer manufacturers but, due to lack of some of the other raw materials, it is rather difficult for some of the fertilizer manufacturers to use the liquor allocated to them.

Ammonia Nitrate

It is understood that considerable quantities of ammonia nitrate will be shipped from Canada and this material will probably ease the situation on nitrate of soda.

Organic Nitrogen

Organic nitrogen is still scarce, all fertilizer manufacturers doing their utmost to obtain whatever supplies are available.

Potash

The War Production Board has issued order M 291 which states that all purchases of potash for shipment after April 1st must be approved by Washington, and no shipments can be made against contracts without such definite approval. Material which has been sold for shipment through March, but which has not been delivered, can be shipped during April without such special approval.

Triple Superphosphate

There has been no easing of this situation whatsoever as the manufacturers are still using their production for the filling of government orders.

The movement of North African rock into England where it can be converted into superphosphate should free triple superphosphate for domestic users after the present orders are completed.

Superphosphate

Superphosphate is extremely scarce and, in many parts of the country, many of the manufacturers are considerably over-sold.

BALTIMORE

Nitrogen Materials Short in All Lines. Russian Potash Arriving. Immediate Increase in Superphosphate Prices Doubtful.

Exclusive Correspondence to "The American Fertilizer"

BALTIMORE, March 9, 1943.

There is nothing new or exciting to report in the fertilizer situation at the present time. The shipping season will soon be on in full force, and it is the consensus of opinion that manufacturers will not be able to fill all their orders, due to lack of sufficient raw material.

Organics.—The demand for organic ammoniates for feeding purposes continues unabated at full ceiling prices, which precludes fertilizer manufacturers from securing ample supplies to offset curtailment of sulphate of ammonia, liquid ammonia and nitrate of soda.

Nitrogenous Material.—Offerings are few and far between, with practically no stocks in the hands of manufacturers.

Sulphate of Ammonia: The Government has been somewhat more lenient in their allocations, but still far below buyers' minimum consumption. There are no resale offerings at all.

Nitrate of Soda: This material likewise continues to be allocated mostly in bulk in this section at previously announced schedule of price, which remains unchanged. The tonnage available for fertilizer purposes is far below manufacturers' requirements.

Potash: Shipments from Russia have somewhat augmented supplies and have been distributed in an orderly way, relieving the uneasiness of some of the larger buyers who are in need of additional supplies. The price remains unchanged.

Superphosphates: No stocks are accumulating in manufacturers' hands, and the situation is gradually strengthening. It is now doubtful whether there will be price adjustment until after the spring season, although the costs of manufacture in the way of increased freight rates, handling and labor have been going up right along.

Bone Meal: The market is practically bare of both raw and steamed bone meal, but with the demand at a minimum, due to prevailing high prices on bone products as compared with other fertilizer materials.

Bags: While shipments of burlap are coming in more regularly, the Government is still taking a large percentage of heavy weights, and there are no burlap bags available for fertilizer purposes. Most fertilizer manufacturers are now using paper bags and it is beginning to look as though burlap bags will be out for the duration as far as fertilizer is concerned.

CHARLESTON

Shortage of Organic Nitrogen Becoming Most Serious in Spite of Increased Allocations. Ammonia Nitrate Imported from Canada.

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, March 9, 1943.

The mill stocks in the south on cottonseed meal are the lowest on record for this time of year, and the shortage of organic nitrogen has now become very serious. The Federal Government, to help the situation, has been releasing some anhydrous ammonia and additional sulphate of ammonia, nitrate of soda, and cyanamid. Some limited amounts of ammonia nitrate from Canada have been released for Arkansas, Mississippi, Louisiana, Virginia, North Carolina, and South Carolina.

Nitrogenous.—No further quantities have become available, and it is now rather doubtful whether any appreciable amount will be available before May.

Castor Meal.—In spite of the recent arrival of nearly three million pounds of beans, the shipments of castor meal are still below normal.

Dried Blood.—This material is still quoted unground at $5.38 per unit of ammonia ($6.53 per unit N), f. o. b. Chicago, but none is available for fertilizer manufacturers.

Cottonseed Meal.—The 8 per cent grade is quoted in Atlanta at $38,60 and soya meal at $44.50, but these are still nominal quotations.

PHILADELPHIA

Short Supply of Ammoniates Still Prevails. Superphosphate Volume Fair. Russian Potash Distributed by U. S. Government.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, March 9, 1943.

Higher testing ammoniates are still very scarce, and no easing of the position is in sight, although more liberal allocations of chemical nitrogen materials may be of some help to the fertilizer manufacturers. The over-all picture of the market situation, therefore, is still the same as previously reported: high demand for organic materials and low supply.

Ammoniates.—The situation is just about as reported above. Some mixers are turning to lower analysis materials and finding some available, although supply is definitely limited.

Sulphate of Ammonia.—Continues to be allocated to mixers.

Nitrate of Soda.—Liberal allocations are being made to the fertilizer manufacturers, for direct application.

Superphosphate.—Is moving out in fair volume on contracts. No decision, as yet, regarding ceiling price.

Bone Meals.—Odd lots of resale material appear from time to time, but supply is still very limited.

Potash.—Shipments are still coming in from Russia, and are being distributed by a Government agency to mixers. Material is now being allocated.

CHICAGO

Little Business Being Done in Fertilizer Organics with Future Sales Refused by Sellers. Feed Supplies Still Short.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, March 8, 1943.

The picture is unchanged in the organic markets. Only slight and scattered business is passing, essentially on an allotment basis. Requests for offerings for deliveries during the next few months were refused by sellers, who seemingly have no fear of a decline in prices in the near future.

It's the old story in the feed line—demand heavier than the supply. Ceiling prices are therefore easily maintained.

No change in ceiling prices. High grade ground fertilizer tankage, $3.85 to $4.00 ($4.68 to $4.86 per unit N) and 10 cents; standard grades crushed feeding tankage; $5.53 per unit ammonia ($6.72 per unit N); blood, $5.38 ($6.54 per unit N); dry rendered tankage, $1.21 per unit of protein, Chicago basis.

TENNESSEE PHOSPHATE

Shipments Still Large With No Stocks Accumulating. Adverse Bill in Tennessee Legislature Failed to Pass.

Exclusive Correspondence to "The American Fertilizer"

COLUMBIA, TENN., March 8, 1943.

Shipments continue active to all consuming channels. Those so far made for direct application exceed the amount shipped in same period of 1942 by 64 per cent. Shipments in all lines are still being made as produced, with little or no stock having a chance to accumulate. Unfilled orders now on hand will cover the entire grinding capacity of the field, but the two new mills purchased by the Hoover & Mason Phosphate Co. have been received and work is being rapidly pushed to get them into operation, which will increase their capacity 65 per cent.

Some large orders have been received from several large rice growers in Texas who have found ground phosphate rock a highly desirable fertilizer for that crop. Large increase is noted of application of this kind of phosphate to the soil by large grazing interests whose cattle have suffered from deficiency diseases from the lack of phosphorus in the soil on which their grass is grown.

The Tennessee Legislature gave the phosphate mining interests a bad scare at the recently closed session, with a bill requiring all mined-over lands to be at once restored "to original contour, with a coating of top soil, to restore its agricultural productiveness." The bill, if passed, would have been a death blow to phosphate miners under present cost conditions and ceiling prices, but it died "in committee."

If WPB restrictions on equipment and material permitted, there would be several new producers developed in this field.

Tobacco beds are made, steamed, fertilized and planted and the great number of white strips of canvas showing over all the hillsides and the large areas plowed and being gotten ready for the transplanting of the valuable weed, indicate that this section may be in for a repetition of the banner tobacco crop of 1942.

Notwithstanding the high phosphorus content of the soil, the growers of this section use quantities of the finely ground phosphate rock as carrier for the poison they apply to the plants, not only in the fields after being set out, but in the beds to the young plants, and most of them insist they get considerable increase from the phosphate thus applied to the leaves. One fine field of young alfalfa in the center of the high-phosphorus soil area has just been top-dressed with 1,000 lb. per acre of finely ground rock. The owner is one of the strong advocates of the idea it helps the tobacco leaves, and wants to see if it does not also help alfalfa.


29

Potash Allocation Order

1. General Preference Order M-291, relative to potash, was issued by WPB on February 27th.

2. The Order places potash under allocation, beginning April 1, 1943. On and after that date, with certain exceptions (see ¶ 10 below), no "supplier" may deliver potash to any person, and no person may accept delivery of potash from a "supplier," except by specific authorization of WPB.

3. "Supplier" includes producers, importers, and wholesale distributors of potash. It does not include fertilizer manufacturers to the extent that they use potash as a raw material, nor retail sellers of potash. Specific authorization is unnecessary for deliveries of mixed fertilizer containing potash, or for retail deliveries of potash made by fertilizer manufacturers, agents, or dealers.

4. Allocations of potash will be made according to periods.

Period 1 includes April and May, 1943; period 2, June, 1943, to March, 1944, both inclusive; period 3, April and May, 1944.

5. In general, the allocation procedure will be as follows: (*a*) A person requiring authorization to accept delivery of potash during any period (whether for consumption or resale) will file an application (on Form PD-600) with WPB. This application will show, among other things, the quantity of each potash salt desired, the purpose for which it is to be used, and the applicant's estimated inventory at the beginning of the period, including amounts undelivered pursuant to (*c*) and (*d*) of ¶ 10 below. (*b*) WPB will issue an authorization showing the quantity of potash the applicant may receive during such period. (*c*) The applicant will place his order or orders for potash, within his authorized total, with a supplier or suppliers. (*d*) The supplier or suppliers will apply to WPB (on Form PD-601) for authorization to make delivery, specifying, among other things, the customer's name and the quantity of each potash salt proposed to be delivered. (*e*) WPB will issue to the supplier an authorization with respect to deliveries that may be made. WPB, however, without adhering to this procedure and at any time, may issue directions with respect to deliveries or uses of potash.

6. To give WPB information as to the total requirements of potash (for use in making equitable allocations to individual applicants), all applications for authorization to accept delivery in any period must be filed well in advance of such period. Similarly, applications by suppliers for authorization to make delivery in any period must be filed shortly after the beginning of such period. Latest dates for filing applications:

For Period	*Authorization to Accept*	*Authorization to Deliver*
1............	March 7, 1943	April 7, 1943
2............	May 1, 1943	July 7, 1943
3............	March 1, 1944	April 7, 1944

7. On or before the 7th day following the commencement of each period, each person who has applied to WPB for authorization to accept delivery during such period must file with WPB (on Form PD-600) information, among other things, as to his inventory of each potash salt at the beginning of the period, including amounts undelivered pursuant to (*c*) and (*d*) of ¶ 10 below.

8. As to the quantities of particular grades of mixed fertilizers to be manufactured from potash or the quantity of potash to be made available for direct application to the soil, authorizations will confirm, as nearly as

practicable, to needs as determined by the Director of Food Production, U.S.D.A.

9. Each person who has been authorized to accept delivery of potash must use it, unless otherwise directed by WPB, only for the purpose authorized.

10. Specific WPB authorization will not be required in the following cases:

(*a*) Delivery may be accepted from all sources, in any period, of not more than one ton of potash, in terms of K_2O content, for each month in such period. A supplier may deliver potash in any period to any person furnishing a certificate to the effect that the potash ordered for delivery in such period, taken with all other potash delivered or to be delivered from all sources in such period, does not exceed one ton for each month of such period, in terms of K_2O content. This is not applicable, however, if the supplier knows or has reason to believe that the certificate is false.

(*b*) Prior to receipt of specific authorization for deliveries in any period, a supplier may deliver in such period to any person not more than 20 per cent of the quantity of any potash salt delivered by him to such person during the corresponding period in the 12 months ending March 31, 1943. Any potash so delivered or received must be charged (1) against the amounts covered by specific authorizations that may be issued and (2) against any amount which may be received or delivered pursuant to item (*a*) above. This exception is apparently intended to take care of deliveries during the first part of any period while WPB is processing the applications for that period.

(*c*) Any undelivered balance under a contract providing for completion of delivery before April 1, 1943, may be delivered and accepted.

(*d*) Any potash which a supplier has been specifically directed by WPB to deliver to any person before May 1, 1943, may be delivered and accepted.

11. For conservation purposes, WPB may issue directions to any person respecting deliveries, storage, transportation, and shipping routes.

12. The prohibitions and restrictions with respect to deliveries apply to deliveries to other persons and also to intra-company deliveries.

13. Applications, reports, appeals, and all other communications concerning the Order must be sent to: War Production Board, Chemicals Division, Washington, D. C.

Preliminary Southern Grade Conference

A preliminary grade conference was held at the Ansley Hotel, Atlanta, Ga., on March 6th, to select tentative lists of grades to be sold in certain Southern States during the 1943 fall and 1944 spring seasons, principally, of course, the latter. The States represented were North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Tennessee, with 30 agronomists attending. Dr. R. W. Cummings, North Carolina, served as chairman, and H. R. Smalley as secretary.

Dr. F. W. Parker, U.S.D.A., chairman, Committee on Fertilizers, American Society of Agronomy, stated that the Committee wished to make tentative recommendations to U.S.D.A. by April 1st if possible, with final recommendations to be ready by May 1st. He urged that fertilizer manufacturers should know, by the end of the present shipping season, the grades to be made next year, so that they will be able to accept delivery of nitrogen solutions beginning in May and to make up stock piles of definite grades, thus reducing labor requirements. Due to the lack of storage facilities for nitrogen solutions, any delay in accepting them at fertilizer plants will mean just that much less nitrogen available for fertilizer use next season. H. B. Siems, S. B. Haskell, and J. R. McCarty expressed similar views. J. W. Turrentine, American Potash Institute, stated that all the available information indicates that there will be no potash shortage next year. The consensus was that chemical nitrogen and phosphate supplies will be adequate but that organic nitrogen supplies may be below normal.

Tentative lists of grades given below were suggested by H. E. Hendricks for Tennessee, W. B. Andrews for Mississippi, N. J. Volk for Alabama, E. C. Westbrook for Georgia, H. P. Cooper for South Carolina, and R. W. Cummings for North Carolina. It should be

understood that these grades are for the fall season of 1943 and spring season of 1944. *Italics* indicate new grades:

North Carolina: 0–10–10 (basic), 0–14–7, 2–8–10 (basic), 2–10–6, 2–12–6, 3–8–5, 3–9–6, 3–9–9, 3–12–6, 4–8–4, 4–8–6(?), 4–8–8, 4–9–3, 4–10–6, 4–12–4, 4–12–8, 5–7–5, *5–10–5*, 5–5–20, *6–6–6*, 10–0–10, and *10–6–4*.

South Carolina: 0–12–0, 0–14–7, 2–12–6, *2–12–12*, 3–9–6, 3–9–9, 3–12–6, *3–12–9*, 4–8–8, *4–10–6*, 4–12–4, 4–12–8, *5–10–5*, *5–10–10*, *6–9–3*, *6–9–6*, *6–6–6*, and *12–0–12*.

Georgia: *0–14–7*, 0–14–10, 2–12–6, 3–8–5, 3–9–6, 3–9–9, 3–12–6, 4–2–10, 4–8–4, 4–8–6, 4–8–8, 4–9–3, 4–12–4, *5–7–5*, *6–8–4*, *6–6–6* or *6–8–8*, and 10–0–10.

Alabama: *0–14–7*(?), 0–14–10, 3–9–9 (tobacco), 4–10–4, 4–10–7, *6–8–4*, and *6–8–8*.

Mississippi: 0–14–7, 4–8–4, 4–8–8, *6–8–4*, *6–8–8* and *6–12–6* or *5–10–5*.

Tennessee: 0–12–12, 0–14–7, *3–8–10*, 2–12–6, 3–9–6 or *3–12–6*, *4–10–7*, 4–12–4, 5–10–5, *6–6–6*, and *6–8–4*.

The grades are similar to those sold this year except that higher nitrogen grades are added. Greater uniformity in adjacent States is also planned. Industry meetings, called either by State control officials, agronomists, or the National Fertilizer Association, will be held in the six States.

Additions to List of Official Grades

The Food Production Administration has announced that a 12–12–0 grade is being added to the Washington, Oregon and Idaho lists, the 16–20–0 grade of Ammo-Phos not being available in sufficient quantity. Also the 6–30–0 grade will be added to the Texas list to meet special needs in west Texas.

Dr. F. W. Quackenbush Heads Indiana Fertilizer Control

Dr. Forrest W. Quackenbush, recently associated with the biochemical department of the University of Wisconsin, has become Indiana State chemist in charge of control of feeds, seeds, fertilizers and plant inoculants. This is a part of his work as successor to Dr. H. R. Kraybill as head of the department of agricultural chemistry at Purdue University and director of agriculture and research at the agricultural experiment station in Lafayette.

CARBON-HYDROGEN RATIOS IN ORGANIC FERTILIZER MATERIALS

(Continued from page 7)

of an organic ammoniate. Some discrepancies exist between these values and the actual availability data by the vegetative and nitrification methods. None of the decidedly inferior materials received a "passing" rating by the neutral method, but this method was poor in distinguishing between substances of good and those of intermediate availability. The special soybean meal is rated too low by both permanganate methods. Process tankages, animal tankage, sewage sludge, Beetle scrap dust, and bone meal are all rated too high by the alkaline method. Peruvian guano has high nitrogen availability, and rates satisfactorily by the neutral method, but its alkaline permanganate number is much too low. This fact has been noted by previous workers, and has been attributed to the presence of uric acid in the guano (2). Uric acid has a low alkaline permanganate number, yet its nitrogen is highly available to plants.

Nitrification of Washed and Unwashed Organics

The nitrification values of the nitrogen of the unwashed organics may be compared with the corresponding values for the washed materials in Table 2. Several unwashed organics containing less than 3 per cent nitrogen, unlike their washed counterparts, gave nitrification values bordering on the satisfactory. The nitrogen of unwashed chicken manure nitrified readily, whereas that

(Continued on page 24 and 26)

The Fertilizer Industry's change-over To MULTIWALL Paper Bags

1939
21,440,000

1940
25,715,000

1941
49,952,000

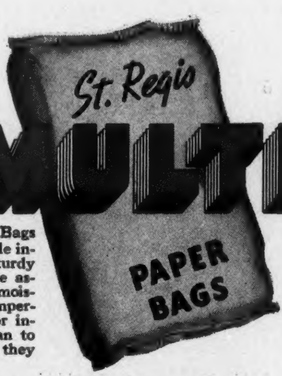
1942 (NINE MONTHS)
95,104,000

1938 was the first year that the fertilizer industry took advantage of economical paper bag sacking. By 1941 the number of Multiwalls used was nearly 50,000,000. In the first *nine* months of *1942*, more than ninety-five million were sold . . . practically twice as many as were used in the *entire* previous year.

Shortages of burlap *and* the fact that St. Regis paper bags are *custom*-built to resist the action of high-analysis fertilizers are boosting sales to new highs.

A St. Regis sales engineer will be glad to demonstrate (in your plant) how easy it is to change-over to paper. Minor alterations at your packing station may be needed but you will require little or no critical metal.

It is a matter of record that no industry which has adopted Multiwall Paper Bags has ever gone back to its former method of packing. Write us. Let us show you what St. Regis specialized service means and how it is saving time and money for others.



MULTIWALL

St. Regis Multiwall Bags are made with multiple independent walls of sturdy kraft paper. They are astoundingly strong, moisture-resistant, and impervious to dust, dirt, or insects. No sifting, clean to handle and store, and they stack well.

MULTIPLY PROTECTION • MULTIPLY SALEABILITY

ST. REGIS PAPER COMPANY

TAGGART CORPORATION • THE VALVE BAG COMPANY

NEW YORK: 230 Park Avenue
CHICAGO: 230 No. Michigan Avenue
BALTIMORE: Baltimore Trust Building

Offices also at: Birmingham, Ala. Dallas, Tex. Denver, Colo. Franklin, Va. Los Angeles, Calif. Nazareth, Pa. New Orleans, La. San Francisco, Calif. Seattle, Wash. Toledo, Ohio

TABLE 2

Carbon-nitrogen Ratios and Nitrogen Availability Ratings of Various Organic Materials

MATERIAL	C–N Ratio	WASHED: Permanganate Activities: Alkaline Method	WASHED: Permanganate Activities: Neutral Method	WASHED: Vegetative test (Sudan grass): Added Nitrogen Recovered in Tops and Roots	WASHED: Nitrification Test: Added Nitrogen Converted to Nitrate 20 Days	UNWASHED: Nitrification Test: Added Nitrogen Converted to Nitrate 20 Days	UNWASHED: Nitrification Test: Added Nitrogen Converted to Nitrate 40 Days
				PER CENT	PER CENT	PER CENT	PER CENT
Seed Meals:							
Soybean meal	4.70	70.1	92.2	59.0	58	61	65
Cottonseed meal	5.40	66.9	82.7	53.6	50	49	54
Special soybean meal	7.05	49.6	73.9	43.9	50	61	66
Castor pomace	9.36	63.0	87.9	51.7	55	60	67
Cocoa meal	14.7	28.8	37.1	....	− 1	14	22
Ground cocoa cake	19.0	33.2	51.5	−25.2	−14	−15	− 5
Plant Materials:							
Alfalfa hay	20.8	28.4	68.9	0.8	4	24	32
Tobacco stems	28.9	19.8	65.4	−25.3	−14	−14	5
Peanut hull meal	53.5	25.9	42.6	−2.6	− 1	15	15
Wheat straw	197.0	....	....	....	−16	−16	−15
Process Tankages:							
Hynite	4.87	73.2	80.9	24.1	24	31	37
Processed tankage	5.17	69.8	81.6	14.7	21	31	35
Agrinite	5.24	68.6	78.8	13.2	18	27	31
Smirow	6.30	64.2	71.8	12.9	13	17	18
Animal Products:							
Hoof meal	3.31	77.1	93.2	50.1	57	65	68
Bone meal	3.46	81.9	39.9	8.8	6	7	10
Dried blood	3.51	81.1	87.9	56.3*	51	60	66
Dry fish scrap	4.42	72.8	86.0	50.1	51	59	63
Animal tankage	5.25	67.1	70.7	29.7	26	37	45
Acid fish scrap	5.28	68.0	87.9	22.0	33	56	61
Manures:							
Peruvian guano	1.28	41.3	96.7	67.8	67	80	77
Bovung	24.4	27.9	47.1	−15.6	−10	0	7
Horse manure	32.7	28.8	51.6	....	−19	−19	−16
Chicken manure	36.4	38.8	59.9	....	−19	22	30
Sewage Products:							
Milorganite	5.98	63.4	75.2	50.5	44	48	53
Nitroganic tankage	6.20	65.1	83.7	37.2	41	44	47
Sewage sludge	13.7	51.1	65.4	8.4	8	11	16
Plastics:							
Beetle molded scrap	1.83	48.0	21.2	− 2.4	1	1	1
Beetle scrap dust	2.35	67.5	79.7	37.2	20	23	30
Ford molded scrap	....	....	....	....	..	− 5	− 3
Ford molding powder	....	....	....	....	..	− 3	− 9
Miscellaneous:							
Cocoa tankage	13.3	30.4	53.8	− 6.9	−7	−2	13
Garbage tankage	13.4	30.6	51.1	−10.0	0	−6	−3
Manito humus	13.7	44.4	40.9	− 5.3	3	3	4
Standard Material:							
Urea	....	....	....	87.9	....	87	88

* Added nitrogen recovered from Sudan grass fertilized with unwashed dried blood was 54.0 per cent.

CARBON-HYDROGEN RATIOS IN ORGANIC FERTILIZER MATERIALS

(Continued from page 24)

of its water-insoluble portion did not. A similar tendency was observed with peanut hull meal, tobacco stems, Bovung, alfalfa hay, and cocoa meal. Ground cocoa cake, wheat straw, and horse manure, both washed and unwashed, proved to be very poor nitrogen sources, the net effect of their decomposition being the tying up not only of all their own nitrogen but of much of the nitrate in the substrate as well.

Of the materials containing more than 3 per cent nitrogen, the differences between the nitrification of the nitrogen of the unwashed and that of the washed materials, in most cases, were not large. The greatest relative differences occurred with acid fish scrap, animal tankage, and the various process tankages. With these products, the nitrogen of the unwashed materials nitrified better than did that of the washed materials, implying that soluble nitrogen of high availability was lost in the washing process.

Nitrification as Related to C-N Ratio

It is a well-known fact that when a large amount of easily decomposable high-carbon organic matter is present in the soil, the microorganisms will feed on this material and, in so doing, will themselves appropriate the nitrogen which it contains, thus limiting, or entirely preventing, the accumulation of nitrates and, in extreme cases, tying up any nitrate in the substrate as well. As the decomposition process continues, however, the C–N ratios narrow and nitrate nitrogen accumulates. As a general rule, therefore, the wider the C–N ratio of a substance, the less immediately available to plants one would expect its nitrogen to be.

Inasmuch as carbon compounds differ in the ease with which they can be utilized by microorganisms, certain sources of carbon are more effective than others in depressing nitrification (6). To illustrate this point, synthetic mixtures containing varying C–N ratios were prepared and put through the nitrification procedure, ammonium sulfate being used as a source of nitrogen, and dextrose, cornstarch, cellulose, cottonseed oil, and lignin as sources of carbon. The data are presented in Table 3.

At C–N ratios of 20 to 1, lignin does not depress nitrification; but cornstarch, dextrose, cellulose, and cottonseed oil exert considerable depressing effect, and in the order mentioned. The nitrification data on mixtures containing various amounts of cellulose clearly illustrate the fact that, for easily decomposable sources of carbon, nitrate accumulation is inversely proportional to the C–N ratio.

To be continued in the next issue

TABLE 3

Nitrification of Mixtures of Carbonaceous Materials and Sulfate of Ammonia

Carbon Source	Carbon Content	C–N Ratio of Mixture	Added Nitrogen Converted to Nitrate 20 Days	40 Days	60 Days
	PER CENT		PER CENT	PER CENT	PER CENT
Lignin	57.2	20:1	86	85	86
Cornstarch	39.0	20:1	49	56	54
Dextrose	35.8	20:1	49	52	50
Cottonseed oil	76.5	20:1	39	45	49
Cellulose	42.0	5:1	77	76	77
Cellulose	42.0	10:1	65	66	66
Cellulose	42.0	20:1	41	45	49
Cellulose	42.0	40:1	−2	7	21
Cellulose	42.0	80:1	−19	−20	−18
No carbon added	....	....	91	83	85

REFERENCES

(1) Fisher, H. L. 1931 Laboratory Manual of Organic Chemistry, ed. 3. John Wiley and Sons, Inc., New York.

(2) Haskins, H. D. 1930 Inspection of commercial fertilizers. Mass. Agr. Exp. Sta. Bul. 54, Control Ser. (See also Bul. 41, 45, and 51, Control Ser., of same station.)

(3) Kelley, W. P. 1915 The biochemical decomposition of nitrogenous substances in soils. Hawaii Agr. Exp. Sta. Bul. 39.

(4) Lipman, J. G., et al. 1911 Report of the soil chemist and bacteriologist. *N. J. Agr. Exp. Sta. Ann. Rpt.* 1911: 159–267.

(5) Tiurin, I. V. 1931 New modifications of the volumetric method of determining soil organic matter by means of chromic acid. *Pedology* 26: 36–47.

(6) Waksman, S. A., and Tenney, F. G. 1927 The composition of natural organic materials and their decomposition in the soil: II. Influence of age of plants upon the rapidity and nature of its decomposition—rye plants. *Soil Sci.* 24: 317–334.

(7) Waksman, S. A., and Stevens, K. R. 1930 A system of proximate chemical analysis of plant materials. *Indus. and Engin. Chem., Analyt. Ed.* 2: 167.

See Page 4

BUYERS' GUIDE • A CLASSIFIED INDEX TO ALL THE ADVERTISERS IN "THE AMERICAN FERTILIZER"

This list contains representative concerns in the Commercial Fertilizer Industry, Including fertilizer manufacturers, machinery and equipment manufacturers, dealers in and manufacturers of commercial fertilizer materials and supplies, brokers, chemists, etc.
For Alphabetical List of Advertisers, see page 33.

ACID BRICK
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

ACID EGGS
Chemical Construction Corp., New York City.

ACIDULATING UNITS
Chemical Construction Corp., New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

AMMO-PHOS
American Cyanamid Co., New York City.

AMMONIA—Anhydrous
Barrett Division, The, Allied Chemical & Dye Corp., New York City
DuPont de Nemours & Co., E. I., Wilmington, Del.
Hydrocarbon Products Co., New York City.

AMMONIA LIQUOR
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
DuPont de Nemours & Co., E. I., Wilmington, Del.
Hydrocarbon Products Co., New York City.

AMMONIA OXIDATION UNITS
Chemical Construction Corp., New York City.

AMMONIATING EQUIPMENT
Sackett & Sons Co., The A. J., Baltimore, Md.

AMMONIUM NITRATE SOLUTIONS
Barrett Division, The, Allied Chemical & Dye Corp., New York City.

AUTOMATIC ELEVATOR TAKEUPS
Sackett & Sons Co., The A. J., Baltimore, Md.

BABBITT
Sackett & Sons Co., The A. J., Baltimore, Md.

BAGS AND BAGGING—Manufacturers
Bagpak, Inc., New York City.
Bemis Bro. Bag Co., St. Louis, Mo.
St. Regis Paper Co., New York City.
Textile Bag Mfrs. Association, Chicago, Ill.
Union Bag & Paper Corporation, New York City.

BAGS—Cotton
Bemis Bro. Bag Co., St. Louis, Mo.
Textile Bag Mfrs. Association, Chicago, Ill.

BAGS—Paper
Bagpak, Inc., New York City
Bemis Bro. Bag Co., St. Louis, Mo.
St. Regis Paper Co., New York City.
Union Bag & Paper Corporation, New York City.

BAGS (Waterproof)—Manufacturers
Bemis Bro. Bag Co., St. Louis, Mo.
St. Regis Paper Co., New York City.
Textile Bag Mfrs. Association, Chicago, Ill.
Union Bag & Paper Corporation, New York City.

BAGS—Dealers and Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

BAG CLOSING MACHINES
Bagpak Inc., New York City.

BAGGING MACHINES—For Filling Sacks
Atlanta Utility Works, East Point, Ga.
Bagpak, Inc., New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

BAG PILERS
Link-Belt Company, Philadelphia, Chicago.

BEARINGS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

BELT LACING
Sackett & Sons Co., The A. J., Baltimore, Md.

BELTING—Chain
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

BELTING—Leather, Rubber, Canvas
Sackett & Sons Co., The A. J., Baltimore, Md.

BOILERS—Steam
Atlanta Utility Works, East Point, Ga.

BONE BLACK
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Huber & Company, New York City.

BONE PRODUCTS
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

BORAX AND BORIC ACID
American Potash and Chem. Corp., New York City.
Pacific Coast Borax Co., New York City.

BROKERS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Dickerson Co., The, Philadelphia, Pa.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Keim, Samuel L., Philadelphia, Pa.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

BUCKETS—Elevator
Link-Belt Company, Philadelphia, Chicago
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

DISINTEGRATORS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DRYERS—Direct Heat
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

ELEVATORS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link Belt Speeder Corp., Chicago, Ill., and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Company, New York City.
Armour Fertiliser Works, Atlanta, Ga.
Farmers Fertiliser Company, Columbus, Ohio.
International Minerals and Chemical Corporation, Chicago, Ill.
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City.

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Duriron Co., Inc., The, Dayton, Ohio.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 13

MACHINERY—Power Transmission
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Pumping
Atlanta Utility Works, East Point, Ga.
Duriron Co., Inc., The, Dayton, Ohio.

MACHINERY—Tankage and Fish Scrap
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MAGNETS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.
Tennessee Corporation, Atlanta, Ga.

MIXERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGEN SOLUTIONS
Barrett Division, The, Allied Chemical & Dye Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
DuPont de Nemours & Co., Wilmington, Del.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Smith-Rowland Co., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

PANS AND POTS
Stedman's Foundry and Mach. Works, Aurora, Ind.

PHOSPHATE MINING PLANTS
Chemical Construction Corp., New York City.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Phosphate Mining Co., The, New York City.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Virginia–Carolina Chemical Corp. (Mining Dept.), Richmond, Va.
Wellmann, William E., Baltimore, Md.

PIPE—Acid Resisting
Duriron Co., Inc., The, Dayton, Ohio.

PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City.
Potash Co. of America, New York City.
International Minerals & Chemical Corp., Chicago, Ill.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., New York City.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

ROUGH AMMONIATES
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

SCALES—Including Automatic Bagging
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SCRAPERS—Drag
Hayward Company, The, New York City.

SCREENS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Including Vibrating
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Magnetic
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corporation, Chicago, Ill., and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Freeport Sulphur Co., New York City.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M. Charleston, S. C.

SULPHURIC ACID—Continued
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

SYPHONS—For Acid
Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
American Agricultural Chemical Co., New York City.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Smith-Rowland, Norfolk, Va.
Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
Huber & Company, New York City.

TANKS
Sackett & Sons, Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
Hayward Company, The, New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
DuPont de Nemours & Co., E. I., Wilmington, Del.

UREA-AMMONIA LIQUOR
DuPont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

WHEELBARROW (See Carts)

ZINC SULPHATE
Tennessee Corporation, Atlanta, Ga.

ALPHABETICAL LIST OF ADVERTISERS

For Classified Index, see pages 28 to 32, inclusive

SODA